US008387638B2

(12) United States Patent
Schroeder et al.

(10) Patent No.: US 8,387,638 B2
(45) Date of Patent: Mar. 5, 2013

(54) **WALKING DEVICE**

(76) Inventors: **Gary L. Schroeder**, Davis, CA (US); **Frank Sivo**, Leonia, NJ (US); **Wang Su**, East Patchogue, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/930,847**

(22) Filed: **Jan. 19, 2011**

(65) **Prior Publication Data**

US 2011/0203627 A1 Aug. 25, 2011

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/660,048, filed on Feb. 20, 2010.

(51) **Int. Cl.**
A45B 3/00 (2006.01)

(52) **U.S. Cl.** **135/66**

(58) **Field of Classification Search** 135/66; 254/124, 126, 134; 297/217.3
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,071,152 A		1/1978	Kinkead et al.	
4,184,380 A		1/1980	Rivin	
RE33,675 E	*	8/1991	Young	180/167
5,259,236 A		11/1993	English	
5,331,990 A		7/1994	Hall et al.	
5,477,211 A	*	12/1995	Reynolds	340/689
5,554,975 A	*	9/1996	Hall et al.	340/573.7
5,755,245 A	*	5/1998	Van Helvoort	135/70
5,794,639 A		8/1998	Einbinder	
5,826,605 A		10/1998	Hilton	
5,853,219 A	*	12/1998	Santuccio	297/5
5,862,824 A		1/1999	Herman	
6,039,064 A		3/2000	Hilton	
6,068,007 A		5/2000	Hilton	
6,163,249 A	*	12/2000	Betcher, III	340/407.1
6,330,888 B1	*	12/2001	Aravantinos et al.	135/66
6,392,556 B2	*	5/2002	Tomich	340/689
6,666,796 B1		12/2003	MacCready, Jr.	
6,745,786 B1	*	6/2004	Davis	135/65
7,398,791 B2	*	7/2008	Tucker	135/66
7,637,273 B1		12/2009	Lisenby	
2004/0144410 A1		7/2004	Cheng et al.	
2006/0129308 A1		6/2006	Kates	
2006/0206167 A1		9/2006	Flaherty et al.	
2008/0072942 A1	*	3/2008	Warren	135/67
2009/0038664 A1	*	2/2009	Juslin et al.	135/66

OTHER PUBLICATIONS

International Search Report and Written Opinion of the International Searching Authority, Apr. 19, 2011, all pages, by International Searching Authority, Alexandria USA.
"Intelligent walking stick", authored by IBM Corporation, published by IP.com, dated Aug. 29, 2006, 2 pages.

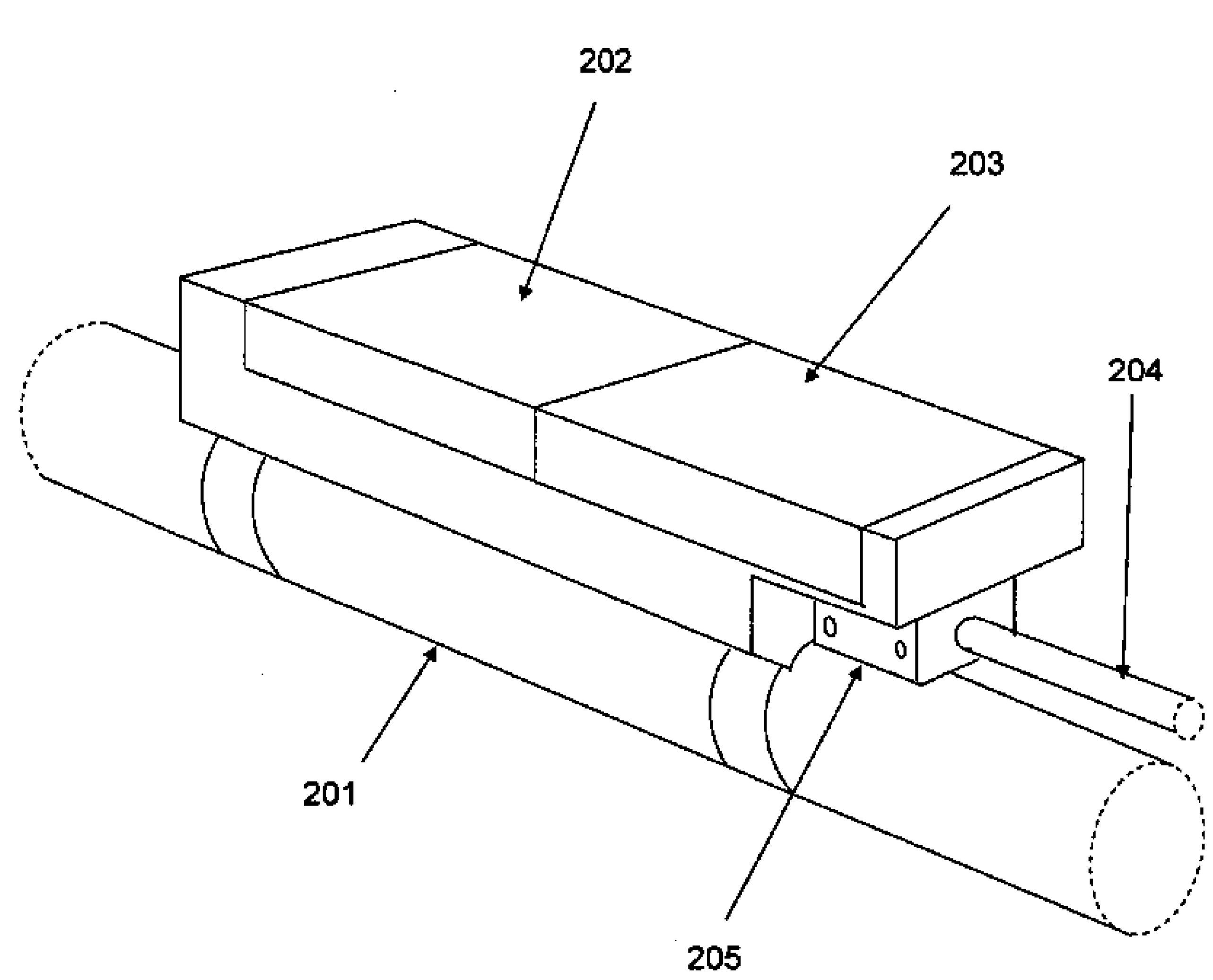
* cited by examiner

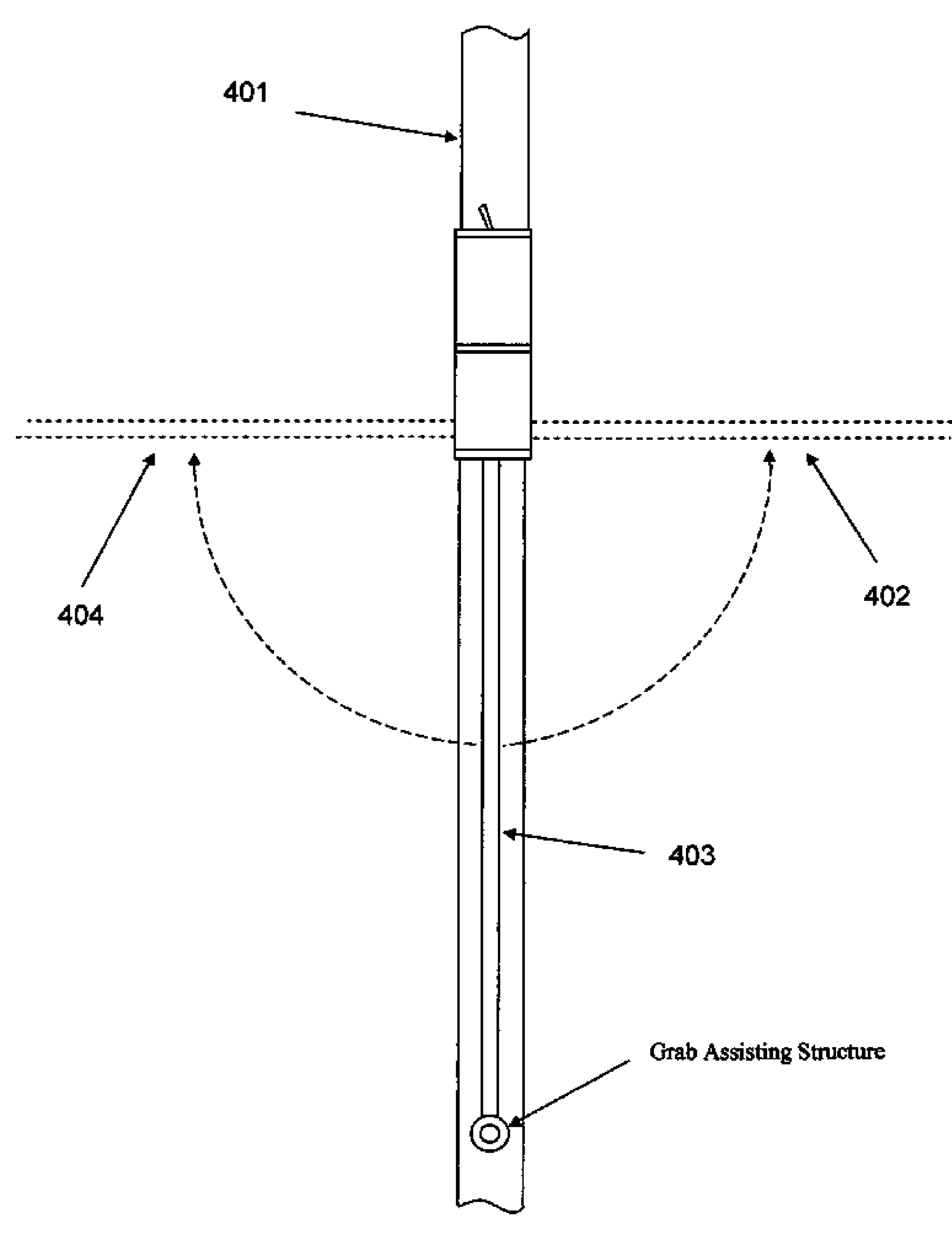
Primary Examiner — Noah Chandler Hawk

(57) **ABSTRACT**

An improved walking device is disclosed wherein the walking device comprises an elongated body that is more than one foot in length, a movable arm coupled to the elongated body, a power source, and a first sensor, and wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, and wherein the electronic signal is capable of at least partially causing a movement of the movable arm.

10 Claims, 12 Drawing Sheets





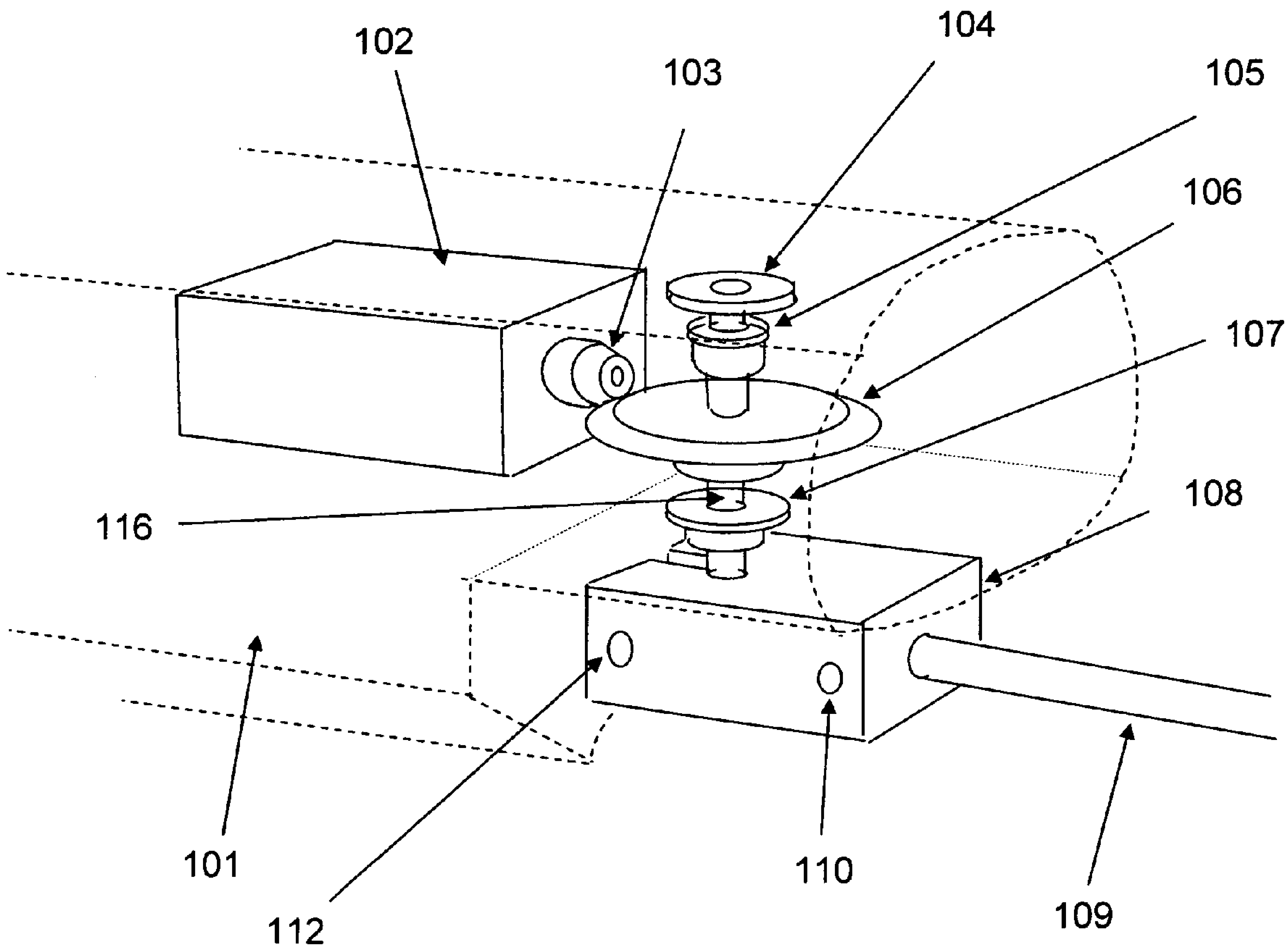


FIG. 1

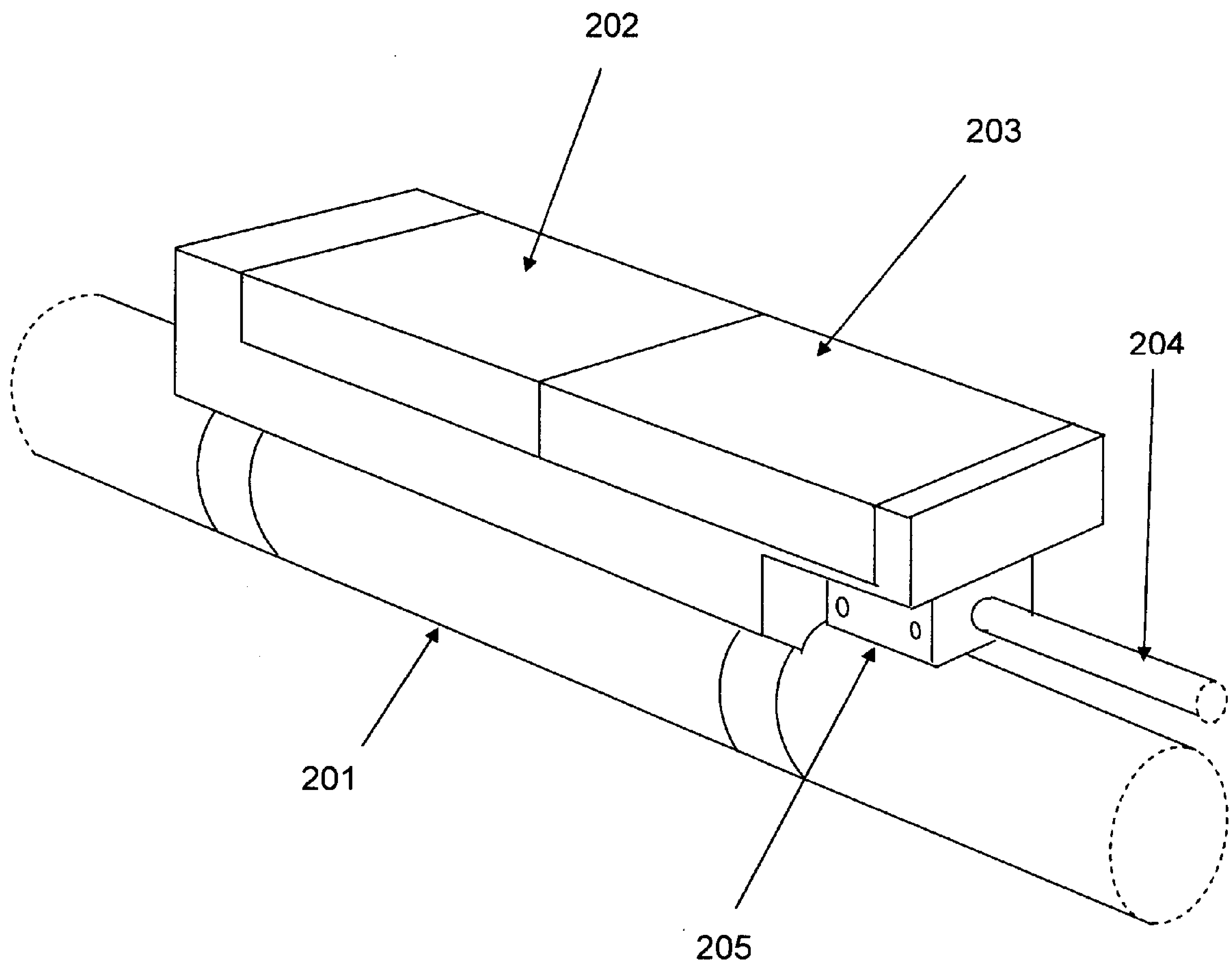


FIG. 2

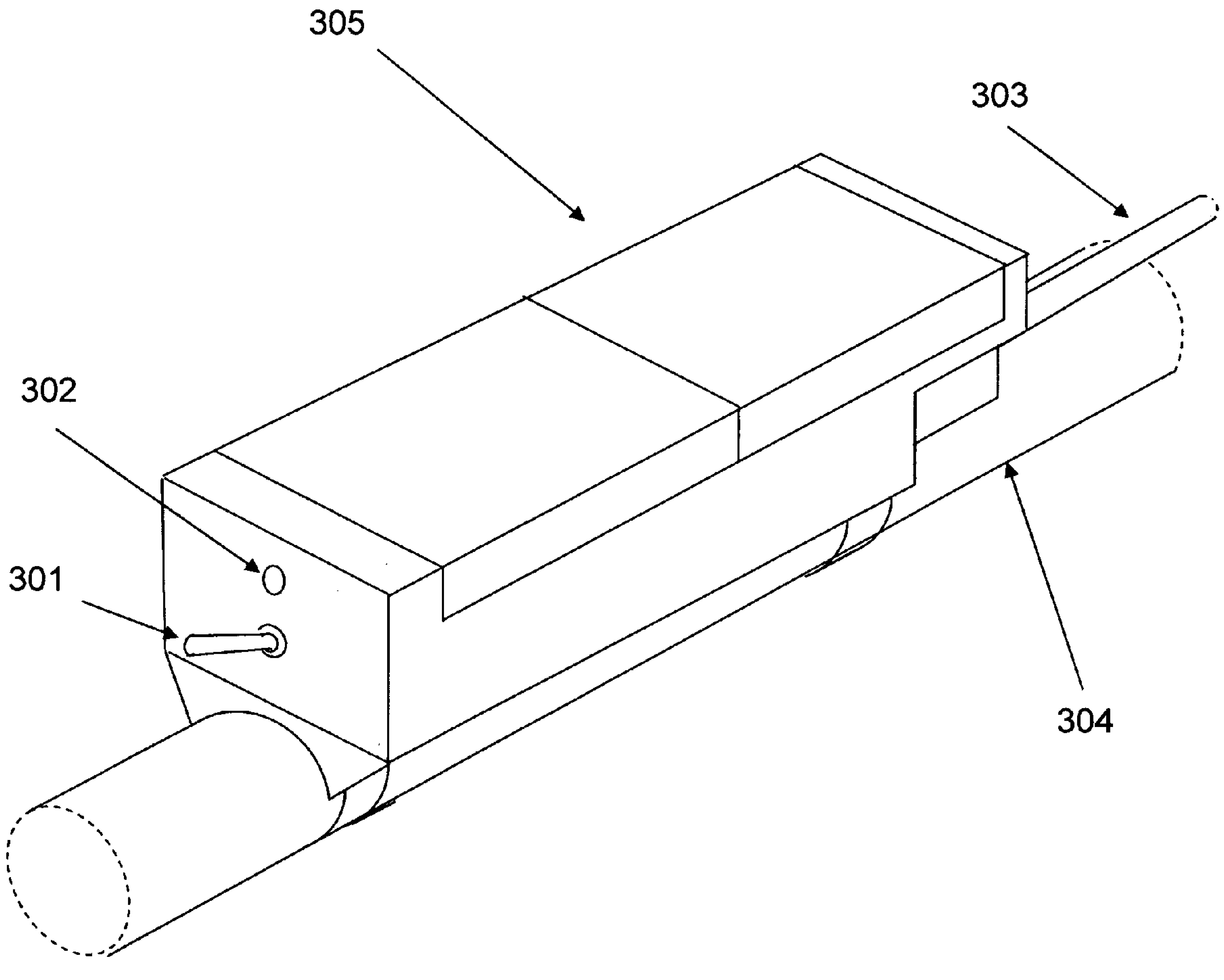


FIG. 3

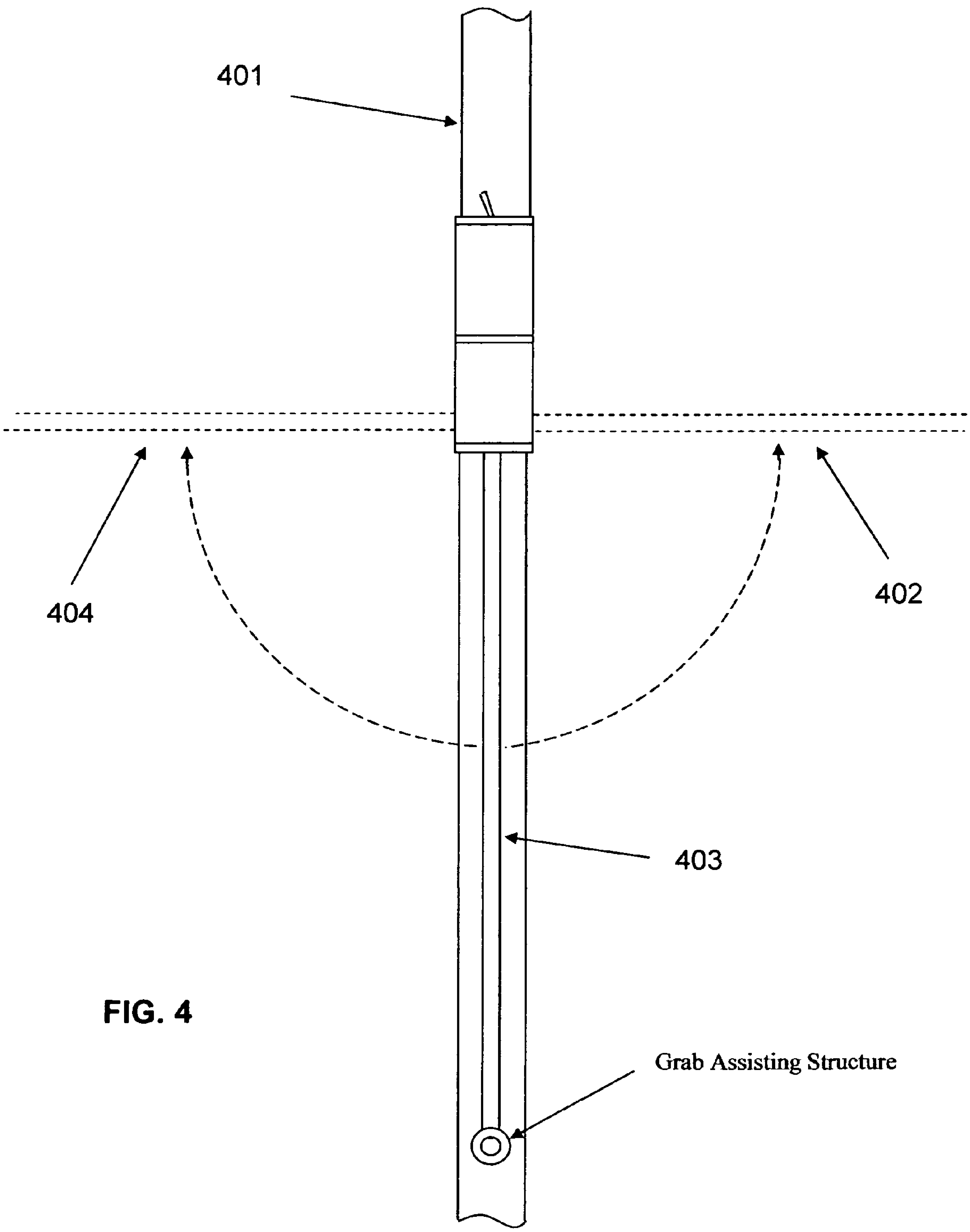
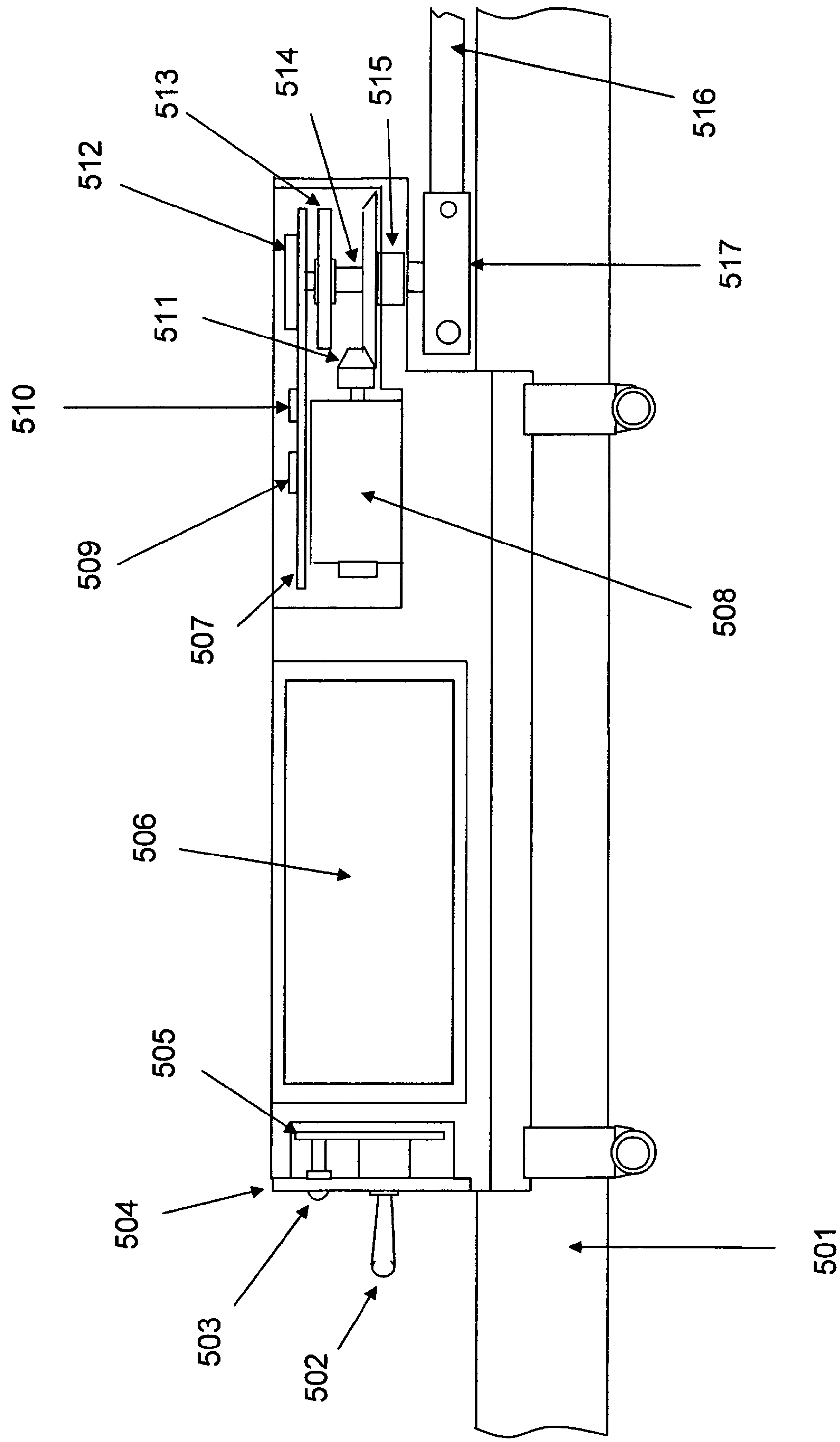


FIG. 4



501
502
503
504
505
506
507
508
509
510
511
512
513
514
515
516
517

FIG. 5

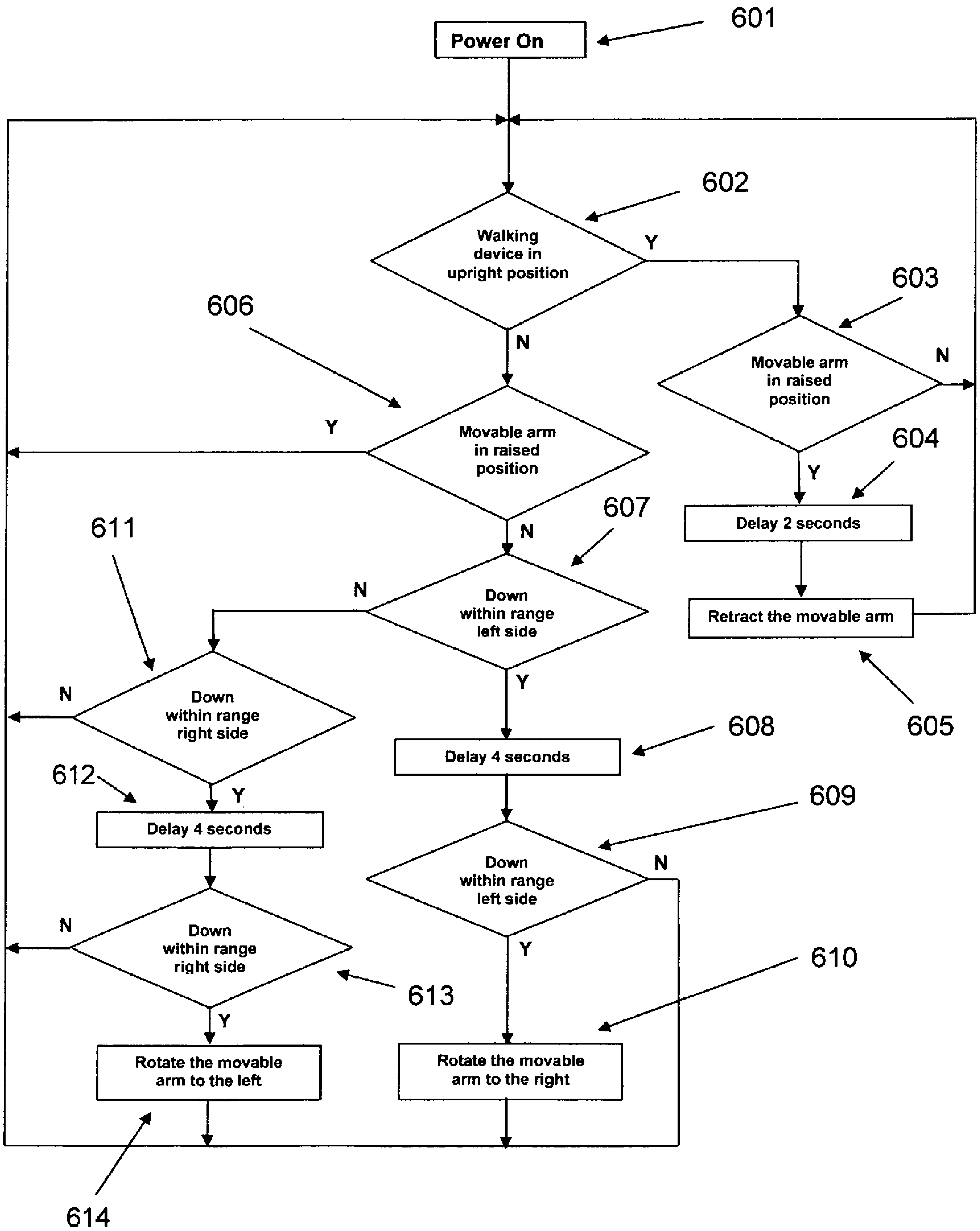

601
Power On
602
Walking device in upright position
Y
N
603
Movable arm in raised position
N
Y
604
Delay 2 seconds
Retract the movable arm
605
606
Movable arm in raised position
Y
N
607
Down within range left side
N
Y
608
Delay 4 seconds
609
Down within range left side
N
Y
610
Rotate the movable arm to the right
611
Down within range right side
N
Y
612
Delay 4 seconds
Down within range right side
N
Y
613
Rotate the movable arm to the left
614

FIG. 6

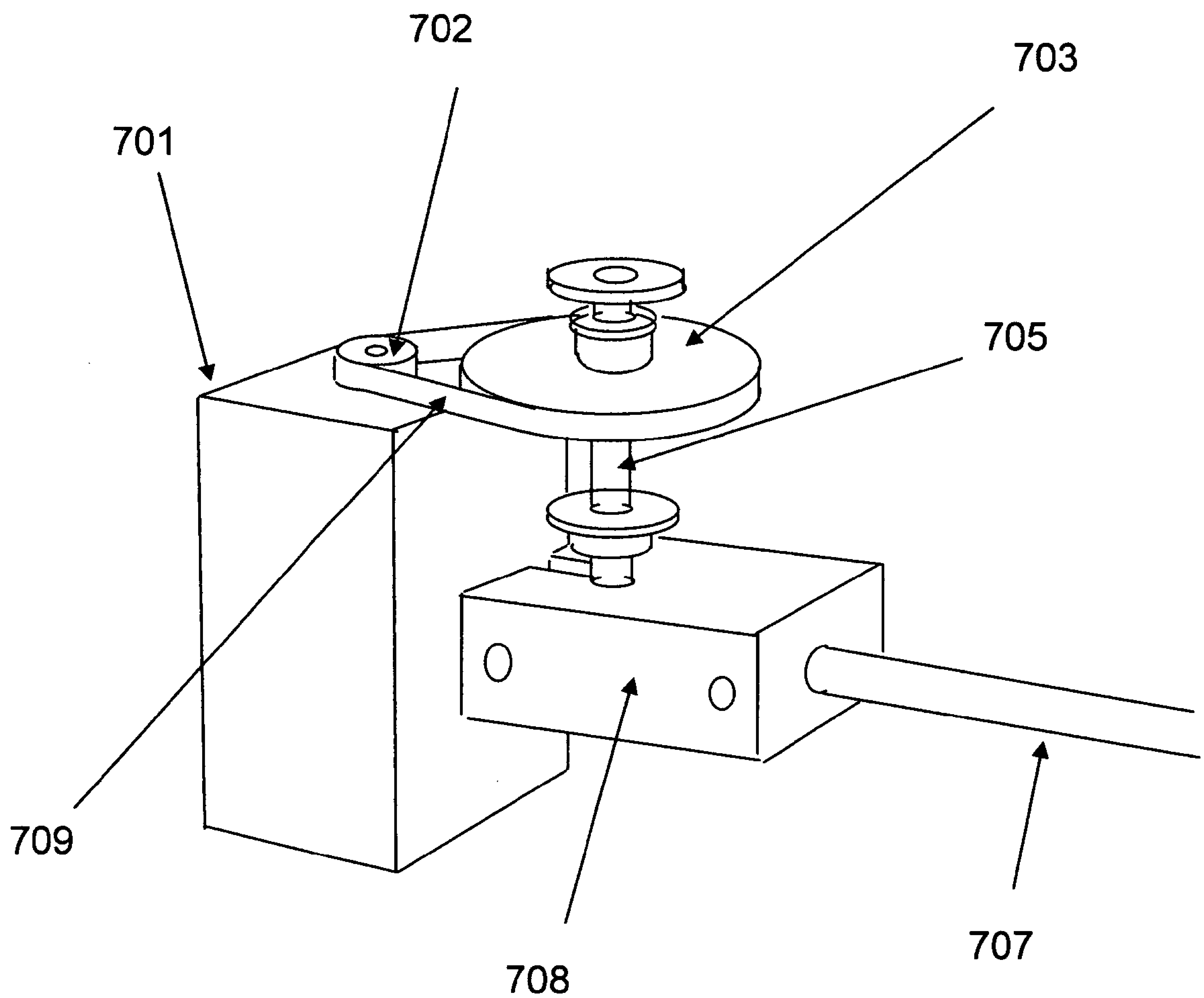


FIG. 7

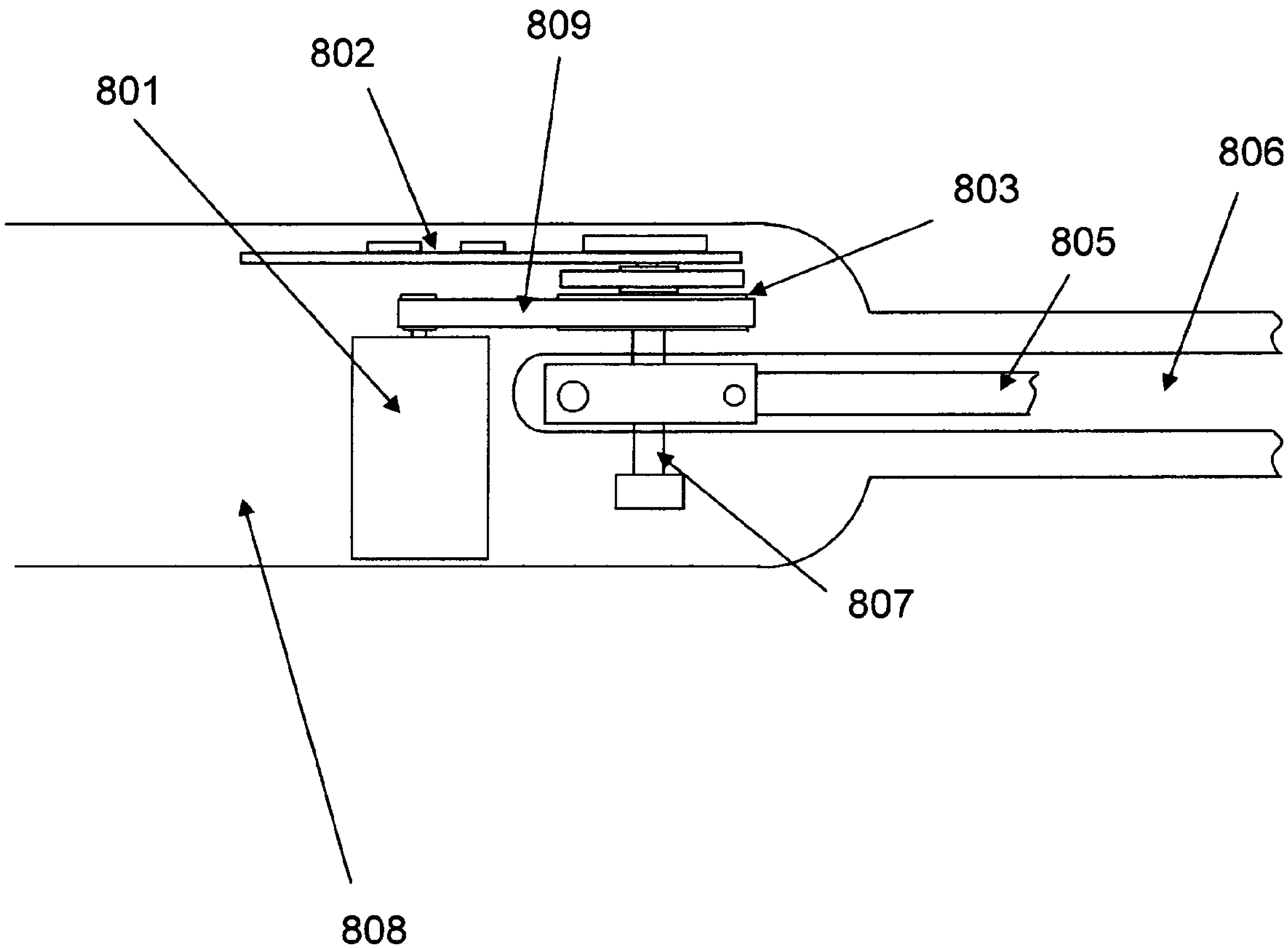


FIG. 8

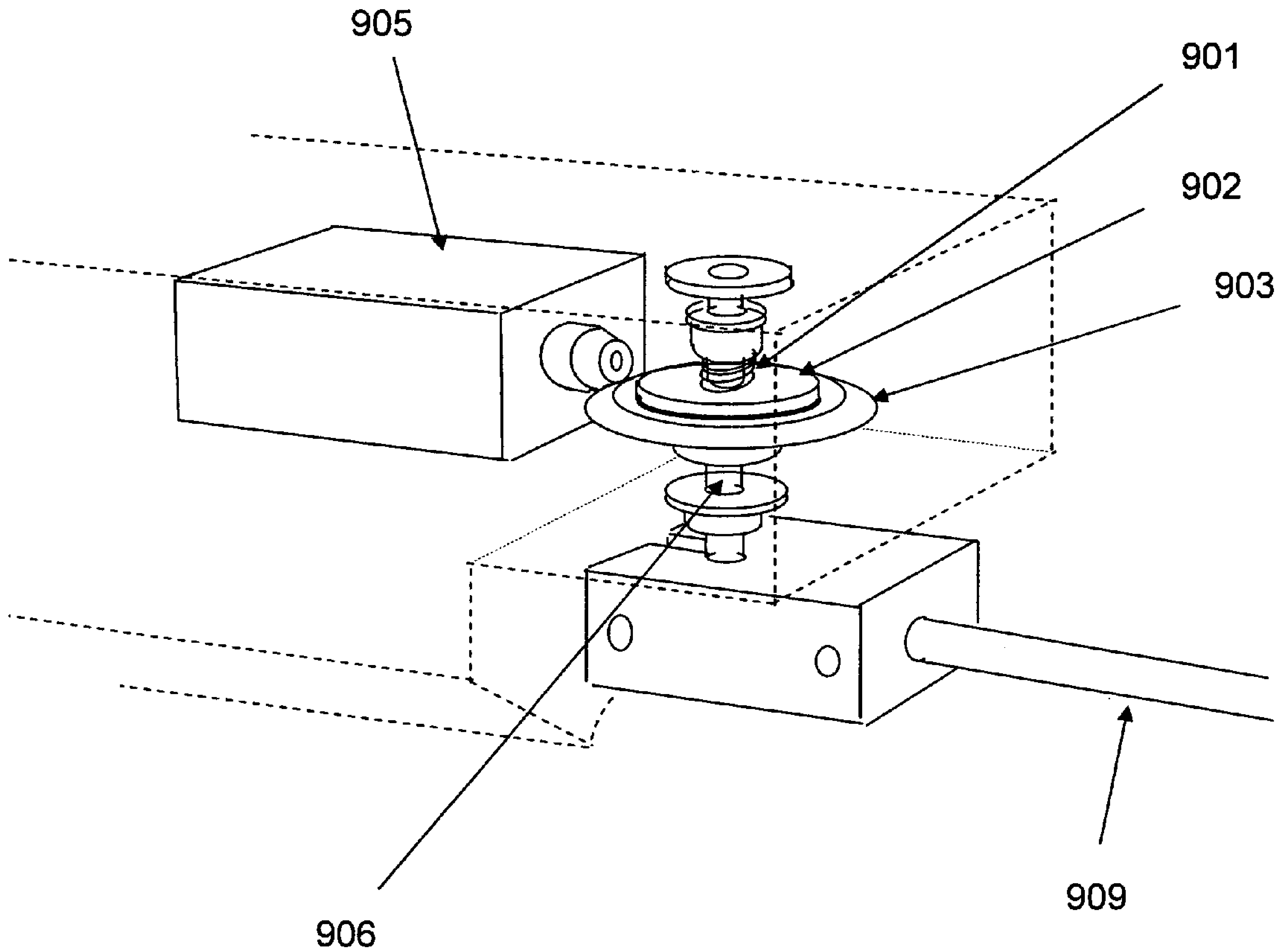


FIG. 9

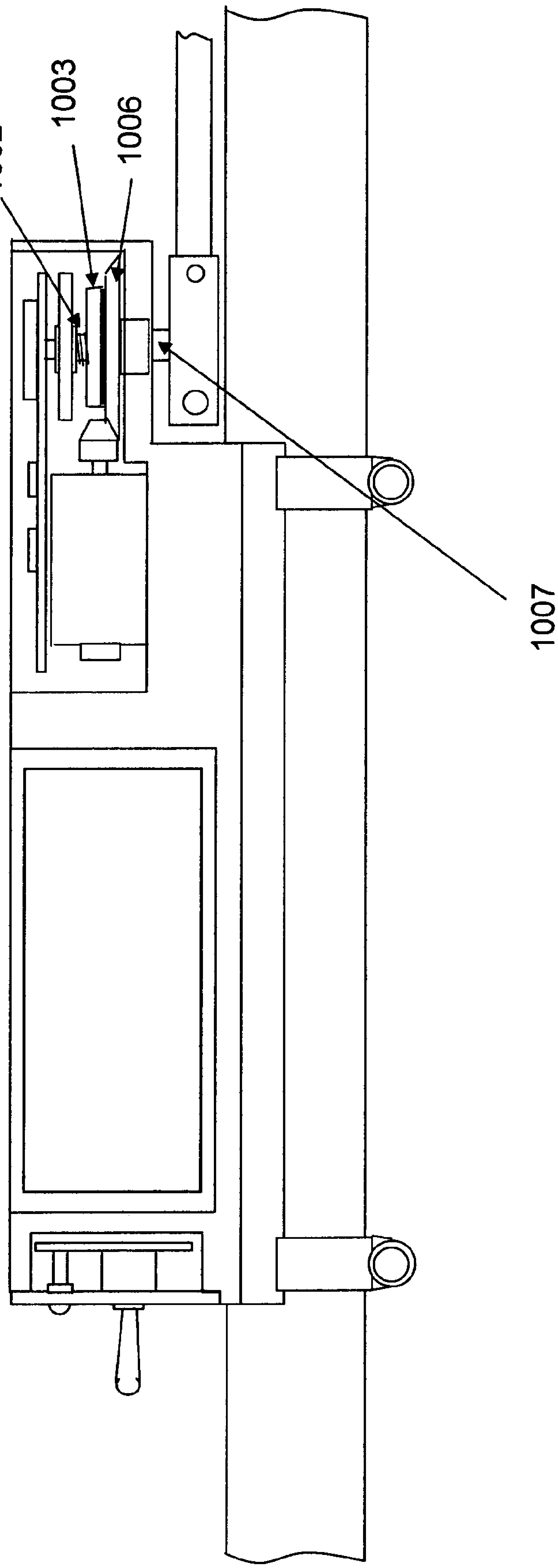


FIG. 10

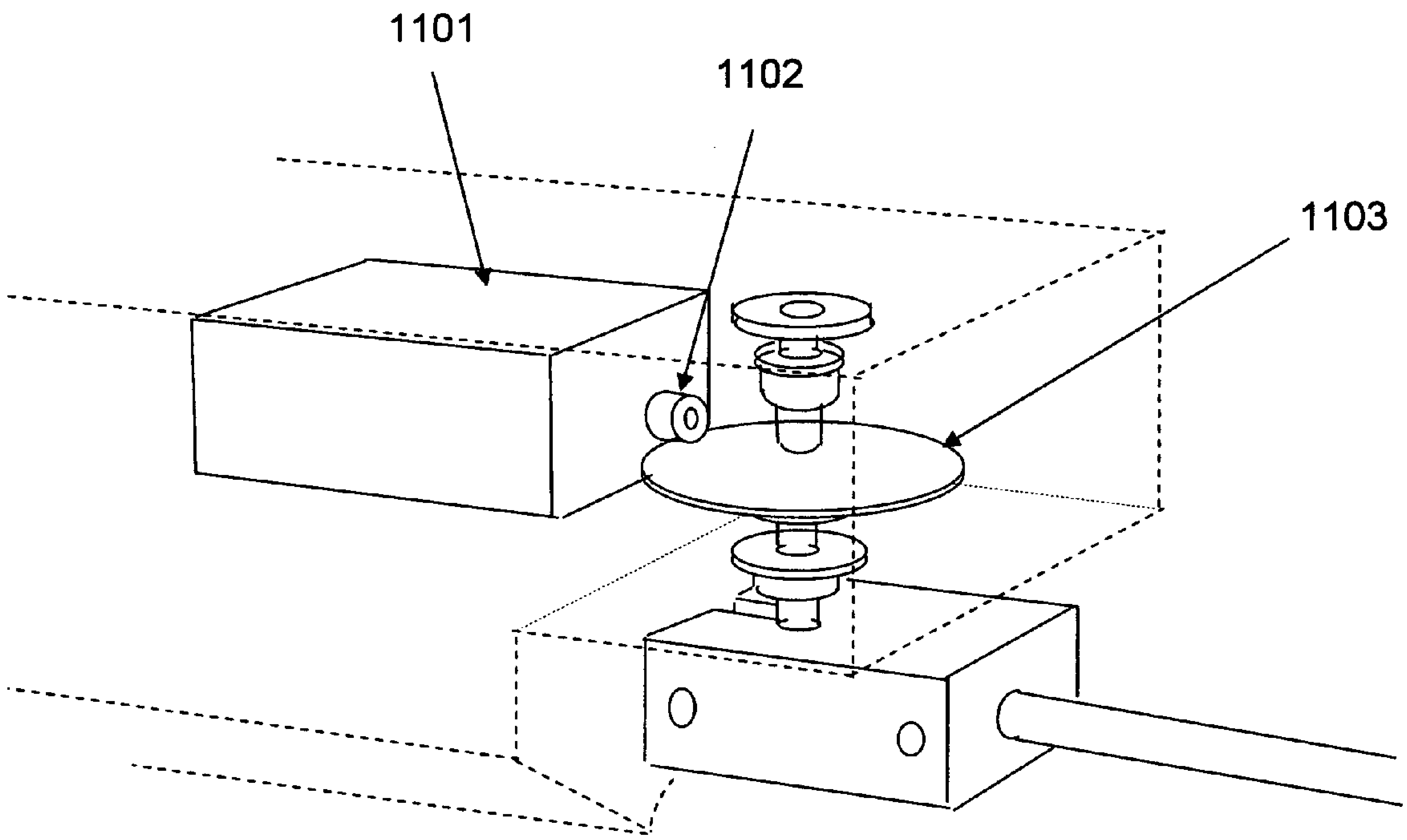


FIG. 11

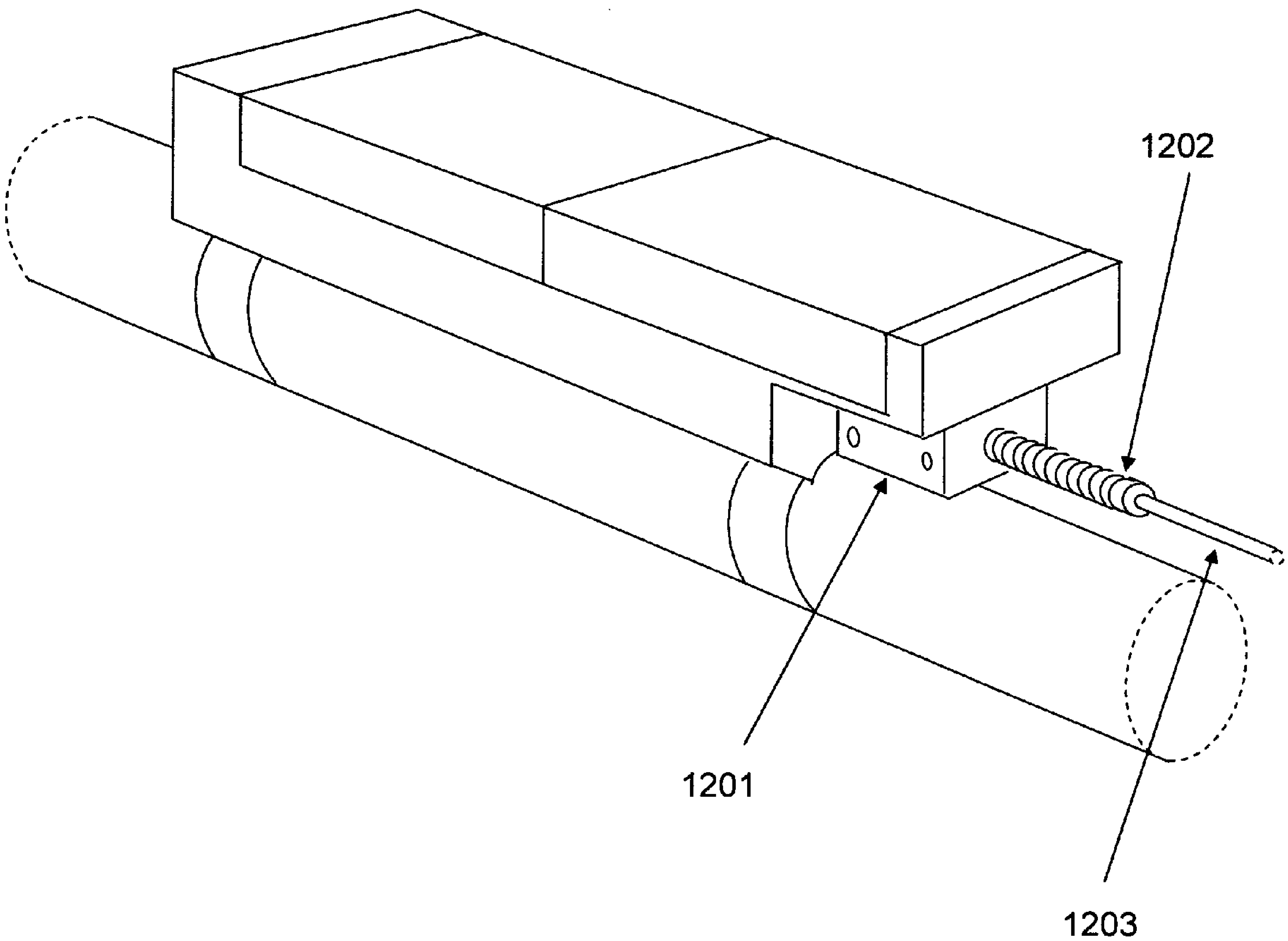


FIG. 12

WALKING DEVICE

This application is a continuation-in-part of pending application Ser. No. 12/660,048, filed Feb. 20, 2010.

FIELD OF INVENTION

The present invention is generally related to an improved walking device, such as a walking cane or a crutch, that is relatively easy to be picked up when dropped on the ground.

BACKGROUND OF THE INVENTION

Presently, many people use devices such as walking canes or crutches to facilitate their movement. Walking canes and crutches can fall from or be dropped by the user, or can fall from any given place of rest. Once they fall on the ground, it could be very challenging for the user to pick them up, because this requires the user to bend over to reach the ground. Normally, those who require a walking cane or a crutch to move around are those with compromised or impaired physical conditions. Bending over to reach the ground could be very difficult for them, if not impossible.

There have been some attempts to solve this problem. For example, U.S. Pat. Nos. 5,826,605, 6,039,064, and 6,068,007 disclosed a design which uses a series of complicated mechanicals to raise an arm when a cane or crutch falls on the ground. The draw back of this design is that it is too complicated, involves too many mechanical parts, and may not be very reliable. Another attempt to solve this problem is described in the paper "Intelligent walking stick". This paper disclosed a walking stick with three prongs that can open up similar to the spokes on an umbrella. The opening up mechanism is based on voice command. When the user speaks a phrase which matches a prerecorded voice signature, the three prongs are opened, resulting in two prongs touching the ground and raising the cane, and the third prong sticking in the air for the user to pick up. This design requires sophisticated voice recognition, which may not work very well in a noisy environment, such as in the streets or in a shopping plaza. Moreover, this design requires three prongs to be installed on a walking device, which complicates the design of the walking device.

Therefore, there is a need for an improved device to facilitate the convenient retrieval of a walking cane or a crutch that is dropped or falls on the ground.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view showing the motor drive assembly of one embodiment of the invention;

FIG. **2** is a side view of one embodiment of the invention;

FIG. **3** is a side view of one embodiment of the invention;

FIG. **4** shows the possible deployment positions of a movable arm according to one embodiment of the invention;

FIG. **5** is an illustrative view of one embodiment of the invention;

FIG. **6** is a flow chart showing illustrative steps that may be followed to perform the improved walking device functions in accordance with one embodiment of the invention;

FIG. **7** is a perspective view showing the motor drive assembly of one embodiment of the invention;

FIG. **8** is a side view of one embodiment of the invention;

FIG. **9** is a perspective view showing the motor drive assembly of one embodiment of the invention with a clutch assembly;

FIG. **10** is an illustrative view of one embodiment of the invention with a clutch assembly;

FIG. **11** is a perspective view showing the motor drive assembly of one embodiment of the invention;

FIG. **12** is a side view of one embodiment of the invention.

DETAILED DESCRIPTION OF POSSIBLE EMBODIMENTS OF THE INVENTION

Possible embodiments of the invention are discussed in this section.

According to one embodiment of the invention, an improved walking device is presented. This walking device could be a walking cane, a crutch, or any other devices that assist in walking. A walking device usually has an elongated body that is more than one foot in length. A sensor is incorporated into the walking device. The sensor senses an orientation of the walking device. The orientation sensor could be an accelerometer or a rate sensor such as a gyroscope. For example, a two axis or three axis accelerometer can sense gravity pull in two or three directions. The gravity pull in two or three directions measured by an accelerometer can be used to indicate a device's relative angle to the ground. The change of gravity pull in those directions can be used to measure the change of orientation of the device relative to the ground. Multiple one axis accelerometers can be used in combination to achieve similar results as a multi-axis accelerometer. Based on the gravity pull in one or more directions, an accelerometer can sense the orientation of a device relative to the ground fairly accurately. It can sense whether the walking device is vertical or horizontal, and if horizontal, which side is up and which side is down. It can also sense increments within the vertical-horizontal axis. The accelerometer produces electronic signals indicating these measurements. There may be other orientation sensing sensors which can be used in the present invention to achieve similar effects. They are also considered part of the present invention. A power source is also incorporated into the walking device which supplies power to the sensor. At least one movable arm is attached to the walking device.

When the improved walking device according to one embodiment of the present invention falls onto the ground, the orientation sensor such as an accelerometer senses an orientation of the elongated body of the walking device, for example horizontal to the ground or vertical to the ground. If the sensed orientation is approximately horizontal to the ground within a range, it suggests that the walking device is likely dropped, then the electronic signal produced by the sensor can cause the movable arm to rise up. The range is to account for the fact that the walking device may rest on an object on the ground or other situations where the walking device is dropped but not perfectly horizontal. If the movable arm's length is about one foot or longer, the walking device's user can grab it without having to bend too much. A more preferred length for the movable arm is about two feet. By grabbing the movable arm, the user can lift the dropped walking device because the movable arm is attached to the walking device. To cause the movable arm to move or rise by the electronic signal produced by the orientation sensor, there are multiple possible embodiments. According to one embodiment of the present invention, the electronic signal produced by the orientation sensor is sent to a microcontroller. The microcontroller then controls the movable arm to move based on the electronic signal. This embodiment will be introduced with greater details later.

According to one embodiment of the present invention, a grab assisting structure is coupled to the movable arm towards the moving end. The grab assisting structure can help the grabbing of the movable arm for the lifting of the walking device. One example of the grab assisting structure is a rubber ball in various shapes attached to the moving end of the movable arm. The grab assisting structure could also be part of the movable arm itself shaped in a way to help grabbing. For example, part of the moving end of the movable arm could be shaped liked a circle, or spiral, or in T shape to form a grab assisting structure for the convenience of grabbing. The grab assisting structure can also be coated or mixed with a fluorescent material so that it glows in the dark for ease of spotting.

According to another embodiment of the present invention, the electronic signal opens a locking device, such as a latch, that locks the movable arm in a closed position. Once the locking device is opened, the movable arm is moved to a raised position by means such as a spring or a counterweight. The spring can be a coil spring or other types of springs. The spring at one end is attached to the walking device, at another end is attached to the movable arm and biases the movable arm to a raised position. Normally, the locking device would lock the movable arm to a closed position. Once the locking device is opened, the spring will bias the movable arm to the raised position. After the walking device is picked up, the user can push the movable arm back to the closed position again. The counter weight acts similar to a spring. The movable arm is installed on a hinge or any other type of fulcrum, and a counter weight is connected to the shorter end of the movable arm. The weight of the counterweight is so that if unhindered, the counterweight will swing toward the ground and move the longer end of the movable arm upwards away from the ground. Normally, the movable arm is locked in a closed position by the locking device against the weight of the counter weight. However, if the locking device is opened, the counter weight will push the movable arm upwards to a raised position. The locking device can be opened by the electronic signal produced by the orientation sensor in many ways. For example, it can be opened by an electric motor controlled by the electronic signal, or it can also be opened by an electromagnetic device controlled by the signal. The electronic signal produced by the orientation sensor can act as a trigger that turns on a current through the electromagnetic device. Once there is a current, the electromagnetic device will produce a magnetic field which can pull the locking device to an opened position.

The movable arm is preferably light in weight so that it can be easily moved. The movable arm can be either stiff or flexible. According to one embodiment of the present invention, the movable arm is made of a material, such as rubber or carbon fiber, which is stiff enough to remain relatively straight but is also flexible so that it can bend easily when it hits an obstacle. This flexible feature is useful to avoid damage if the movable arm hits an object when rotating.

FIG. **1** is a perspective view showing the motor drive assembly of one embodiment of the present invention driving a movable arm. A drive assembly is an assembly of components that drives the movable arm. Various different drive assemblies are described in different embodiments of the present invention. According to this embodiment, movable arm **109** is moved by a motor drive assembly including a motor **102**. The motor **102** is controlled by a microprocessor and an orientation sensing sensor which are not shown in this figure. The motor **102** has a bevel pinion gear **103** mounted on its shaft. The bevel pinion gear **103** drives a larger bevel gear **106** that is attached to an output drive shaft **116**. The movable arm **109** is attached to the output drive shaft **116** by an attachment clamp hub **108**. Screws **110** and **112** can be used to attach the output drive shaft **116** and the movable arm **109** to the attachment clamp hub **108**. Top bearing **105** and bottom bearing **107** facilitates the movement of the output drive shaft **116**. The motor **102** output speed can vary, for example it can be about 45 rotations per-minute. The larger bevel gear **106** reduces the rotational speed to increase the turning force at the output drive shaft **116**. For example it reduces the rotational speed by one third, the resulting rotational speed of the output drive shaft **116** is about 15 rotations per-minute. This will cause the movable arm **109** to move ninety degrees in about one second. If the movable arm **109** is in a position that is approximately horizontal compared to the ground. After moving ninety degrees vertically, it will become approximately vertical compared to the ground.

According to another embodiment of the invention, a second sensor **104** is coupled to the output drive shaft **116**. The second sensor **104** can be a potentiometer. A sensor such as a potentiometer can sense the rotational position of the movable arm **109** and produce an electronic signal feedback indicating the rotational position of the movable arm **109**. The electronic feedback from the second sensor together with the electronic signal produced by the orientation sensor can both be used by the microprocessor to control the movement of the motor **102**.

According to one embodiment of the present invention, the motor and gear assembly as shown in FIG. **1** are built into a cane, or a crutch, or other walking assistants, together forming an improved walking device. A walking device such as a cane or a crutch can have a hollowed interior with room enough to contain the motor and gear assembly. Enclosure **101** in this embodiment shows a section of the improved walking device with the motor and gear assembly installed within. The movable arm **109** can be installed outside but near a surface of the improved walking device so that it is rotatable around the output drive shaft **116**. According to another embodiment of the present invention, the motor and gear assembly can be enclosed in an independent enclosure to form a module. The module can then be attached to a cane, or a crutch, or other walking assistants to form an improved walking device. User can either choose to buy a new improved walking device with the design built into it, or, if the user already has a cane or crutch, he or she can choose to just buy a module and attach it to the existing walking device to form an improved walking device.

FIG. **2** is a side view of one embodiment of the present invention. According to this embodiment, movable arm **204** is attached to a drive assembly by an attachment hub **205**. The drive assembly is enclosed in compartment **203** as a module. A power assembly coupled to the drive assembly is enclosed in compartment **202**. The entire module is attached to walking device **201**. FIG. **3** is another side view of one embodiment of the invention. According to this embodiment, movable arm **303** is movably attached to module **305**. Module **305** may include a drive assembly, an orientation sensing sensor, a microprocessor, and a power supply. Module **305** may also include a secondary sensor that senses the rotational position of movable arm **303**. A power switch **301** can be built into module **305** to turn the power on and off. A low power indicator **302** can also be built into module **305** to give warnings when the power supply is at a low level. The module **305** can be attached to a walking device **304** to form an improved walking device.

FIG. **4** shows the possible deployment positions of a movable arm according to one embodiment of the invention. If the orientation sensing sensor senses that the improved walking device **401** is in a vertical position, it keeps the movable arm **403** parallel to the improved walking device **401**. The improved walking device **401** can be shaped in the way that when it falls on the ground, either its left side rests on the ground or its right side rest on the ground. For example, the improved walking device **401** can have a "U" shaped, "T" shaped, or "F" shaped top so that the physical structure of it dictates that only its right side or its left side can rest on the ground when dropped. It is also possible that without a special shaped top, the structure of the improved walking device **401** is overall relatively flat, or has two flat surfaces on two opposing sides, therefore when it is dropped on the ground, only the right or the left side can rest on the ground. When the improved walking device **401** falls on the ground and rests on its left side, the built in orientation sensor, such as a multi-axis accelerometer, not only senses that the improved walking device **401** is now horizontal rather than vertical, but also sense that it is the left side of the device that is resting on the ground. Once the sensor senses that the improved walking device **401** is dropped and the left side is on the ground, it products electronic signals to cause the movable arm to move to the right vertically into position **402**. When in vertical position **402**, the movable arm **403** can be grabbed by the user without having to bend too much. On the other hand, when the improved walking device **401** falls on the right side, the sensor senses it and produces electronic signals to cause the movable arm **403** to move vertically to the left position **404**. As mentioned earlier, the electronic signal can cause the movable arm **403** to move by many means, for example by controlling a motor with a microprocessor or by opening a locking device to allow a spring or a counterweight to move the movable arm **403**.

FIG. **5** is an illustrative view of one embodiment of the present invention. According to this embodiment, movable arm **516** is attached to output shaft **514** by a clamp hub **517**. Orientation sensor **510**, for example a two or three axis accelerometer, is mounted on circuit board **507**. Orientation sensor **510** senses the orientation of walking device **501**. A second sensor **512**, for example a potentiometer, is attached to the output shaft **514** and is also mounted on the circuit board **507**. The second sensor **512** senses the rotational position of movable arm **516** because they are both attached to the output shaft **514**. A sensor such as a potentiometer can give out different electronic signals based on the changing rotational positions of a rotating shaft. These electronic signals can be used to indicate the rotational position of objects attached to the rotating shaft, such as the movable arm **516**. A microcontroller **509** is mounted on the circuit board **507**. The microcontroller **509** has a built in microprocessor. The microcontroller **509** may either have a built in memory or is connected to an external memory. A software program is either stored in the built in memory or is stored in the external memory connected to the microcontroller **509**. The microprocessor within the microcontroller **509** is capable of executing the software program and performing the control functions. The microcontroller **509** receives electronic signals generated by orientation sensor **510** indicating the orientation of the walking device **501**, it also receives electronic signals generated by the second sensor **512** indicating the rotational position of movable arm **516**. Based on this information, the microcontroller **509** controls a motor **508** by executing a software program. The motor **508** has a driving gear **511** that drives the output shaft **514** by driving another gear connected to the output shaft **514**. Bearings **513** and **515** facilitate the movements of output shaft **514**. A power source **506** is coupled to the circuit board **507** to supply power to the sensors **510** and **512**, the microcontroller **509**, and the motor **508**. The power source **506** could be a number of batteries. A power control circuit board **505** is coupled to the power source **506**. A cover plate **504** covers the power control circuit board **505**. A power switch **502** is mounted on the power control circuit board **505** to turn the power on and off. A low power indicator **503** is mounted on the power control circuit board **505** to give warning signals if the power level is low.

According to one embodiment of the present invention, when movable arm **516** rotates with the output shaft **514**, sometime it may touch an object and get stuck. When this happens, the motor **508**'s movement will be inhibited resulting in the motor **508** drawing higher than normal amount of current. The microcontroller **509** checks the motor **508**'s current draw during the movement of the movable arm **516**. If the microcontroller **509** detects unusual amount of current, the microcontroller **509** can either reverse the driving direction of motor **508** so that the movable arm **516** reverses its rotational direction. The microcontroller **509** can also stop the motor **508**, and try to restart the motor **508** after some time to see if the blocking object has been removed or not.

FIG. **6** is a flow chart showing illustrative steps that may be followed to perform the improved walking device functions in accordance with one embodiment of the invention. According to this embodiment, the user turns on a power source at step **601**. The power source supplies power to a driving system. The system includes an orientation sensor that senses the orientation of a walking device, an optional second sensor that senses the position of a movable arm, a microprocessor, a memory that stores a software program executable by the microprocessor, and a motor. At step **602**, the orientation sensor sends electronic signals to the microprocessor which indicate whether the walking device is in an upright position or not. At steps **603** and **606**, the second sensor sends electronic signals to the microprocessor which indicate the position of the movable arm. Microprocessor receives these electronic signals and decides next steps. At step **603**, if the walking device is in an upright position and the movable arm is not raised, then the program loops back to step **602**. On the other hand, if the walking device is in an upright position and the movable arm is raised, this indicates that the walking device was probably dropped and then picked up after the movable arm has been raised. In this situation, at step **604**, an optional timer counts a predetermined time, for example 2 seconds, before entering step **605**. The timer can be achieved by the software program setting up counting registers within the microprocessor to count internal master clock pulses until a required count total is reached. The timer can be achieved by other methods as well. At step **605**, the microprocessor controls the motor to move the movable arm back to the position where it is parallel to the walking device.

At step **606**, if the signals received by the microprocessor indicate that the walking device is not in an upright position and the movable arm is raised, then the program loops back to step **602**. However, if the walking device is not in an upright position and the movable arm is not raised, then at step **607** the microprocessor makes a further determination from the electronic signal received from the orientation sensor whether the walking device is on the left side within a certain range from a horizontal position. Giving it a range is to count for the fact that the walking device may not be perfectly horizontal even if dropped on the ground. If the answer is yes, a timer counts a delay time, for example 4 seconds, at step **608**. The timer is similar to the timer introduced above at step **604**. To introduce a time delay has benefits such as allowing the dropped walking device to enter into a relatively stable state. After the time delay, at step **609**, the microprocessor takes another electronic signal from the orientation sensor to make a determination if the walking device is still on the left side within a certain range from a horizontal position. If the answer is yes, then at step **610** the microprocessor controls the motor to move the movable arm to the right until it reaches a predetermined position, preferably 90 degrees rotation from its current position. The rotational position can be detected by the second sensor such as a potentiometer. If the answer at step **609** is no, then the program loops back to step **602**.

At step **607**, if the microprocessor determines that the walking device is not on the left side within a certain range from a horizontal position, then at step **611** the microprocessor makes a further determination from the electronic signal received from the orientation sensor whether the walking device is on the right side within a certain range from a horizontal position. If the answer is no, then the program loops back to step **602**. If the answer is yes, a timer counts a delay time, for example 4 seconds, at step **612**. After the time delay, at step **613**, the microprocessor takes another electronic signal from the orientation sensor to make a determination if the walking device is still on the right side within a certain range from a horizontal position. If the answer is yes, then at step **614** the microprocessor controls the motor to move the movable arm to the left until it reaches a predetermined position, preferably 90 degrees rotation from its current position. If the answer at step **613** is no, then the program loops back to step **602**. This is just one embodiment of the present invention. Different steps or different orders of the steps can be performed to achieve similar results.

According to another embodiment of the present invention, when the walking device is within a certain range from a horizontal position, the microprocessor determines the degree by which the walking device is off the horizontal position by taking the measurements from the orientation sensor, and compensates for that when rotating the movable arm. For example, if the walking device is 20 degrees off the horizontal position, then instead of rotating the movable arm for 90 degrees, the microprocessor controls the motor to rotate the movable arm for only 70 degrees, so that the movable arm ends up to be approximately perpendicular to the ground after the rotation.

FIG. **7** is a perspective view showing the motor drive assembly of one embodiment of the invention. According to this embodiment, movable arm **707** is driven by a motor **701** through a gear assembly. The motor **701** has a gear **702** mounted on its shaft. The gear **702** drives a larger gear **703** by a timing belt **709**. The larger gear **703** is attached to an output drive shaft **705**. The movable arm **707** is attached to the output drive shaft **705** by an attachment clamp hub **708**. FIG. **8** is a side view of one embodiment of the invention. According to this embodiment, a motor and gear assembly such as that shown in FIG. **7** is built into a cane, or a crutch, or other walking assistants, forming an improved walking device. According to this embodiment, the walking device **808** has the motor and gear assembly as well as the circuit board **802** installed within. The walking device **808** has an opening **806** which is like an opening slot that goes through part of the elongated body of the walking device **808**. The opening **806** is long enough so that the movable arm **805** can swing through. The movable arm **805** is attached to an output drive shaft **807**. The output drive shaft **807** is driven by motor **801** through a timing belt **809** and a gear **803**. The output drive shaft **807** can also be driven by motor **801** through other drive assemblies such as bevel gears as described above. When the movable arm **805** is in a rested position, it can rest within the opening **806**. If the walking device **808** falls to the ground, the motor assembly can drive the movable arm **805** through the opening **806** to the correct direction in accordance with the methods introduced in the present invention.

FIG. **9** is a perspective view showing the motor drive assembly of one embodiment of the invention with a clutch assembly. According to this embodiment, gear **903** is made to turn freely on the output drive shaft **906**. A clutch plate **902** is attached to the output drive shaft **906** in such a way that the clutch plate **902** presses against gear **903**. One way of achieving this pressure force is by using a clutch pressure spring **901**. The friction of the clutch plate **902** pressing against gear **903** transfers the rotational force of gear **903** to output drive shaft **906** thus moving the output drive shaft **906**, which in turn moves the movable arm **909**. In this particular embodiment, motor **905** drives gear **903** through a bevel gear system. In a different embodiment of the present invention, motor **905** can drive gear **903** through a timing belt system as described above. By implementing the clutch assembly, the movable arm **909** can better absorb external forces. FIG. **10** is an illustrative view of one embodiment of the invention with a clutch assembly. According to this embodiment, gear **1006** is attached to the output drive shaft **1007** and can turn freely on it. A clutch plate **1003** is also attached to the output drive shaft **1007** and is pressured against gear **1006** by a clutch pressure spring **1002**. When gear **1006** turns, the friction force between gear **1006** and clutch plate **1003** turns clutch plate **1003**, which then drives the output drive shaft **1007**.

FIG. **11** is a perspective view showing the motor drive assembly of one embodiment of the invention. According to this embodiment, at least one of gears **1102** and **1103** is coated with rubber or any other rubber like materials. Gear **1103** is preferably larger that gear **1102**. Both gear **1102** and gear **1103** could be coated with rubber. When motor **1101** drives gear **1102**, gear **1102** in turn drives gear **1103** by the friction force created by the rubber coating. The mechanism could also act as an inherent clutch because at a certain given amount of pressure gear **1102** could slide across the surface of gear **1103** thus prevent gear **1102** from taking too much force. The entire drive assembly could be built into a module, it could also be built directly into the walking device. When the drive assembly is built into the walking device, it can be built in a way that it is easily accessible for the user to repair.

FIG. **12** is a side view of one embodiment of the invention. According to this embodiment, a spring **1202**, which is preferably relatively stiff, is attached to a drive assembly through attachment hub **1201**. A movable arm **1203** is attached to the other end of the spring **1202**. Where there is strong external force, the spring **1202** could absorb part of the stress by bending, thereby protecting the drive assembly.

According to another embodiment of the present invention, a rotational stop is provided to prevent over rotating the movable arm. The rotational stop is placed in a location shortly beyond the movable arm when the movable arm is in a fully extended position. When the movable arm extends to its extended position, the rotational stop will not interfere with the movement. However, if the movable arm over rotates beyond its designed extended position, it will hit the rotational stop, and the rotational stop will prevent the movable arm from moving beyond its normal extended position. The rotational stop could be part of the housing containing the drive system. There could also be multiple rotational stops to prevent over rotating in more than one direction.

According to one embodiment of the present invention, to reduce power consumption, the microprocessor is normally in a sleep mode and is self-timed to wake up for a few microseconds once each second. During each wake up period of the sleep mode, the microprocessor checks the electronic signals from the orientation sensor to determine the orientation status of the walking device, and electronic signals from the second sensor to determine the rotational position of the movable arm. If the walking device is in an upright position and the movable arm is not rotated to the left or to the right, the microprocessor will return to sleep and remain in the sleep mode. Otherwise, the microprocessor exits the sleep mode and rotates the movable arm to a position according to the program. Once the walking device returns to the upright position and the movable arm is parallel to the walking device, the microprocessor can enter into the sleep mode again.

It is obvious that there are numerous different variations and combinations of the above described embodiments of the invention. All these different variations, combinations and their structural or functional equivalences are considered as part of the invention. The terms used in the specification are illustrative and are not meant to restrict the scope of the invention. The described methods have steps that can be performed in different orders and yet achieve similar results. All the variations in the design components or orders of the method steps are considered as part of this invention as long as they achieve substantially the same results.

The invention is further defined and claimed by the following claims.

We claim:

1. A walking device comprising:

an elongated body that is more than one foot in length;

a movable arm coupled to the elongated body;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear; and

a first sensor;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm, and wherein the drive assembly comprises a motor and a microprocessor, wherein the motor is electronically coupled to the microprocessor, and wherein the microprocessor is capable of controlling the motor at least partially based on the electronic signal produced by the first sensor.

2. The walking device of claim **1** further comprising a second sensor different from the first sensor, wherein the second sensor is capable of sensing a rotational position of the movable arm, and wherein the microprocessor is capable of controlling the motor at least partially based on an output of the second sensor.

3. A walking device comprising:

an elongated body that is more than one foot in length;

a movable arm coupled to the elongated body;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear;

a first sensor; and

a clutch assembly;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, and wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm.

4. A walking device comprising:

an elongated body that is more than one foot in length;

a movable arm coupled to the elongated body;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear; and

a first sensor;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm, and wherein the first gear and the second gear directly engage each other, wherein the first gear is smaller than the second gear, and wherein the second gear is capable of driving the movable arm through an output shaft.

5. A walking device comprising:

an elongated body that is more than one foot in length;

a movable arm coupled to the elongated body;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear; and

a first sensor;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm, and wherein the first gear and the second gear engage each other through a timing belt, wherein the first gear is smaller than the second gear, and wherein the second gear is capable of driving the movable arm through an output shaft.

6. A module for attaching to a walking device comprising:

a movable arm;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear; and

a first sensor;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm, and wherein the drive assembly comprises a motor and a microprocessor, wherein the motor is electronically coupled to the microprocessor, and wherein the microprocessor is capable of controlling the motor at least partially based on the electronic signal produced by the first sensor.

7. The module of claim **6** further comprising a second sensor different from the first sensor, wherein the second sensor is capable of sensing a rotational position of the movable arm, and wherein the microprocessor is capable of controlling the motor at least partially based on an output of the second sensor.

8. A module for attaching to a walking device comprising:

a movable arm;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear;

a first sensor; and

a clutch assembly;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, and wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm.

9. A module for attaching to a walking device comprising:

a movable arm;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear; and

a first sensor;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm, and wherein the first gear and the second gear directly engage each other, wherein the first gear is smaller than the second gear, and wherein the second gear is capable of driving the movable arm through an output shaft.

10. A module for attaching to a walking device comprising:

a movable arm;

a power source;

a drive assembly, wherein the drive assembly comprises a first gear and a second gear; and

a first sensor;

wherein the first sensor is capable of detecting an orientation of the walking device and producing an electronic signal based on the orientation, wherein the orientation reflects an angular position of the walking device, wherein the drive assembly is capable of at least partially causing a rotational movement of the movable arm, and wherein the first gear and the second gear engage each other through a timing belt, wherein the first gear is smaller than the second gear, and wherein the second gear is capable of driving the movable arm through an output shaft.

* * * * *